Introduction:

Tasked with improving Intrepid's current hardtop design, we realized that some of the current problems with the hardtop design are the weight and the aerodynamic characteristics and how they affect the vessel performance. Improving the hardtop design will allow us to achieve our key goal of enhancing boat performance among others.

We used the interpreted needs to help shape our functional decomposition process regarding the improvement of the hardtop. Aerodynamics, vessel capability, and weight reduction were among the top areas of discussion. Considering this, our design should be lighter, enhance aerodynamic properties, and advance vessel performance.

Data Generation:

Data was gathered for this project through meeting with our sponsor, Richard Ahl. We asked Richard a series of questions and through his responses were able to interpret his needs and gather the required data to complete the functional decomposition for this project. Richard made it clear that our goal is to lighten the 409 Valor's hardtop while increasing its aerodynamic properties. Richard wants us to accomplish these goals while keeping cost to a minimum. Through this meeting, we were given parameters to work within to meet our customers goal.

Action and Outcome:

The expected action of this project is the improvement of the current hardtop used on the 409 Valor. This action is expected to give outcomes of decreased hardtop weight, improved aerodynamic properties and increased on water performance. The main goal is improving on water performance. This will be accomplished by decreasing the hardtop's weight and improving the hardtop's aerodynamic properties. The lightened hardtop must still maintain enough structural rigidity to support the weight of a service person working on the vessel as well as the aerodynamics forces and loads. The aerodynamic properties needed to be advanced in such a way that any cost expended has a high return on investment in order to keep the improvements practical. The chart below shows our flow from taking actions and outcomes and turning them into systems and functions.

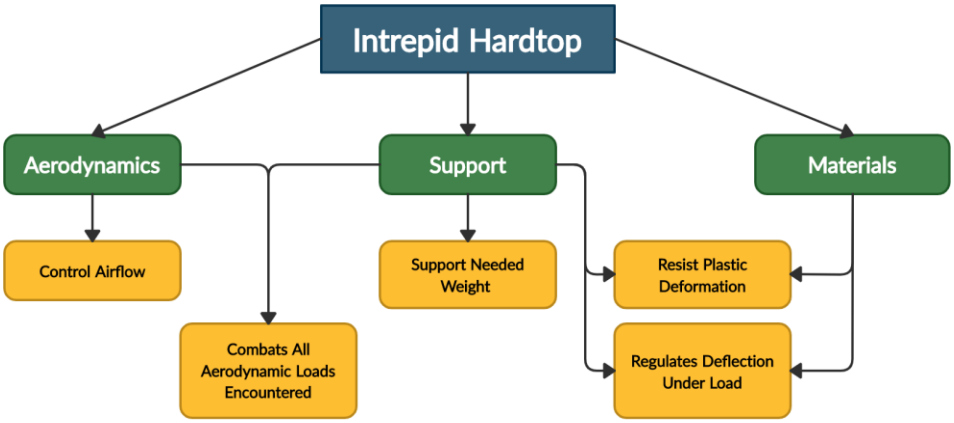

Figure 1: Flow Chart

Smart Integration:

Smart integration shows which functions are interrelated with other systems. This allows for innovating solutions and shows how more can be done with less. The chart below lists all functions and systems and shows which functions impact multiple systems and which functions are singular to one system. The 'Resists Plastic Deformation' function connects the 'Materials' and 'Support' systems. Cyclic plastic deformation could occur overtime from environmental conditions or from increased loading on top of the hardtop from service persons or equipment. Selecting materials that maintain their rigidity overtime when exposed to the elements can possibly help in our improved hardtop. The mechanical properties of the materials will also be important when considering support in the hardtop. The 'Regulates Deflection Under Load' function is a component of both the 'Support' and 'Materials' systems. Resisting deflection will help a service technician feel stable and maintain balance while on the hardtop conducting repairs or upgrades. Keeping deflection low can be a result of the materials used to manufacture the hardtop. The 'Combats All Aerodynamic Loads Encountered' function relates the 'Aerodynamics' and 'Support' systems. The design may incorporate certain geometrical changes that allow the hardtop to generate lift or reduce drag while also providing for a more reliable mode of mounting. The hardtop could include shape changes that allow more surface area for mounting, making the hardtop more secure, while contributing to improved aerodynamics in those areas.

Functions / Systems	Supports Needed Weight	Resists Plastic Deformation	Regulates Deflection Under Load	Combats All Aerodynamic Loads Encountered	Controls Airflow
Support	X	X	X	X	
Aerodynamics				X	X
Materials		X	X		

Figure 2: Cross Reference Table

Connection to Systems:

The figure above gives a good visual representation of how the systems and functions are related. For the 'Support' system, it is expected that the changes will not affect the hardtop's ability to hold the necessary weight required by Intrepid. The 'Support' system shares functions with the other two systems. The first is the resistance to plastic deformation within both the materials system and the support system. The second is the regulation of deflection under load within both the materials system and the support system. The third function shared between systems is the hardtops ability to combat all aerodynamic loads that are encountered by the vessel while on the water. The system of 'Aerodynamics' has a function that is not shared with other systems. This function is controlling airflow during operation. This is important for satisfying our customer's needs.

The system with the highest priority is the 'Support' system. It has the most functions within it as well as sharing the most functions across multiple systems. The reason this system is the highest priority is because without thoroughly achieving these functions, the hardtop will not be able to be implemented onto the vessel. The second highest priority system is the 'Materials' systems because it shares multiple functions with the highest priority system and requires all functions in order to complete our project effectively. The 'Aerodynamics' function is the lowest priority but is still extremely important to our project because it contains the functions regarding on water performance, a focus of Intrepid's design.

Function Resolution:

Through innovation and analysis, a hardtop will be developed that withstands all loads while remaining aerodynamic and manufacturability. The hardtop will be mounted in the same fashion as the current design so that it will retain its use on the current Intrepid 409 Valor. Using certain materials to the design's advantage, we can manipulate the hardtop's rigidity, structural integrity, and weight to get desired engineering characteristics. The materials used in the design will play a big part in the overall success of the design, and when combined with geometry changes, aerodynamics and airflow can be tailored to the customer's needs.